CLAIMS

What is claimed is:

1. A plasma reactor comprising:

a chamber enclosure having a process gas inlet and defining a plasma processing region;

a workpiece support pedestal capable of supporting a workpiece at processing location facing said plasma processing region, said pedestal and enclosure being spaced from one another to define a pumping annulus therebetween having facing walls, to permit process gas to be evacuated therethrough from the process region;

a pair of opposing plasma confinement magnetic poles within one of said facing walls of said annulus, the opposing magnetic poles being axially displaced from one another;

said magnetic poles being axially displaced below said processing location by a distance which exceeds a substantial fraction of a spacing between said facing walls of the annulus.

2. The reactor of Claim 1 further comprising a connector of magnetic material within said one wall connecting the opposing poles.

3. The reactor of Claim 1 wherein the one wall of the annulus comprises a removable liner, and wherein said poles are within said removable liner.

4. The reactor of Claim 2 wherein said magnetic poles are ring shaped and are concentric with said annulus and wherein said connector is ring shaped and concentric with said annulus, whereby the opposing poles and the connector define a cylindrical horseshoe magnet.

5. The reactor of Claim 2 wherein said connector is formed separately from said opposing magnetic poles, and wherein said connector is magnetized and said magnetic poles comprise magnetically permeable material.

6. The reactor of Claim 2 wherein said connector is formed separately from said opposing magnetic poles, and wherein said magnetic poles comprise magnetized material and said connector comprises magnetically permeable material.

7. The reactor of Claim 1 wherein said one wall is an inner wall.

8. The reactor of Claim 1 wherein said one wall is an outer wall.

9. The reactor of Claim 1 wherein the axial displacement below the processing location is several times the spacing between said facing walls.

10. The reactor of Claim 1 wherein the axial displacement of said magnetic poles below said processing location is sufficient so that the magnetic field near the processing location is on the order of about 50 times less than the magnetic field across said annulus on the vicinity of the magnetic poles.

11. The reactor of Claim 10 wherein the magnetic field at the processing location is near or less than about 3 Gauss and within the annulus is near or greater than about 150 Gauss.

12. The reactor of Claim 1 wherein said axial displacement below the processing location exceeds a substantial fraction of the distance between said opposing poles.

13. The reactor of Claim 12 wherein said axial displacement below the processing location is several times the distance between said opposite poles.

14. The reactor of Claim 1 in which the opposite poles are oriented such that they provide their maximum magnetic flux in the direction across the annulus.

15. The reactor of Claim 14 which the opposite poles comprise a horseshoe magnet.

16. The reactor of Claim 15 in which the opposite poles are connected by a magnetically permeable connector.

17. The reactor of Claim 1 which further includes a horseshoe magnet arrangement having a pair of legs respectively terminating in said opposite poles, with at least one ring magnet comprising one leg of the horseshoe arrangement, and with the remainder of the arrangement being of magnetically permeable material.

18. A plasma reactor comprising:

a chamber enclosure having a process gas inlet and defining a plasma processing region;

a workpiece support pedestal capable of supporting a workpiece at processing location facing said plasma processing region, said pedestal and enclosure being spaced from one another to define a pumping annulus therebetween having facing walls, to permit process gas to be evacuated therethrough from the process region;

a pair of opposing plasma confinement magnetic poles within one of said facing walls of said annulus, the opposing magnetic poles being axially displaced from one another;

said magnetic poles being axially displaced below said processing location by a distance which is sufficient so that the magnetic field adjacent the workpiece plane is on the order of about 50 times less than the magnetic field across said annulus adjacent the magnetic poles.

19. A plasma reactor comprising:

a chamber enclosure having a process gas inlet and defining a plasma processing region;

a workpiece support pedestal capable of supporting a workpiece at processing location facing said plasma processing region, said pedestal and enclosure being spaced from one another to define a pumping annulus therebetween having facing walls, to permit process gas to be evacuated therethrough from the process region;

a pair of opposing plasma confinement magnetic poles within one of said facing walls of said annulus, the opposing magnetic poles being axially displaced from one another;

said magnetic poles being axially displaced below said processing location by a distance which exceeds a substantial fraction of the distance between said opposing poles.

20. A plasma reactor comprising:

a chamber enclosure having a process gas inlet and defining a plasmas processing region;

a workpiece support pedestal capable of supporting a workpiece at processing location facing said plasma processing region, said pedestal and enclosure being spaced from one another to define a pumping annulus therebetween having facing walls, to permit process gas to be evacuated therethrough from the process region;

a pair of opposing plasma confinement magnetic poles within one of said facing walls of said annulus, the opposing magnetic poles being axially displaced from one another;

said poles being displaced from said processing location by a distance substantially greater than the smallest distance across said annulus, said poles being oriented to provide maximum magnetic flux across said annulus and a minimum of said flux adjacent said processing location.